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BEAVER DAM LAKE (SOUTH BASIN), BARRON COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Wisconsin Department of Natural Resources

June 1975

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
BEAVER DAM LAKE (SOUTH BASIN)
BARRON COUNTY
WISCONSIN
EPA REGION V
WORKING PAPER No. 69

WITH THE COOPERATION OF THE
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
AND THE
WISCONSIN NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

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* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries and nutrient sources were not sampled, and this report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

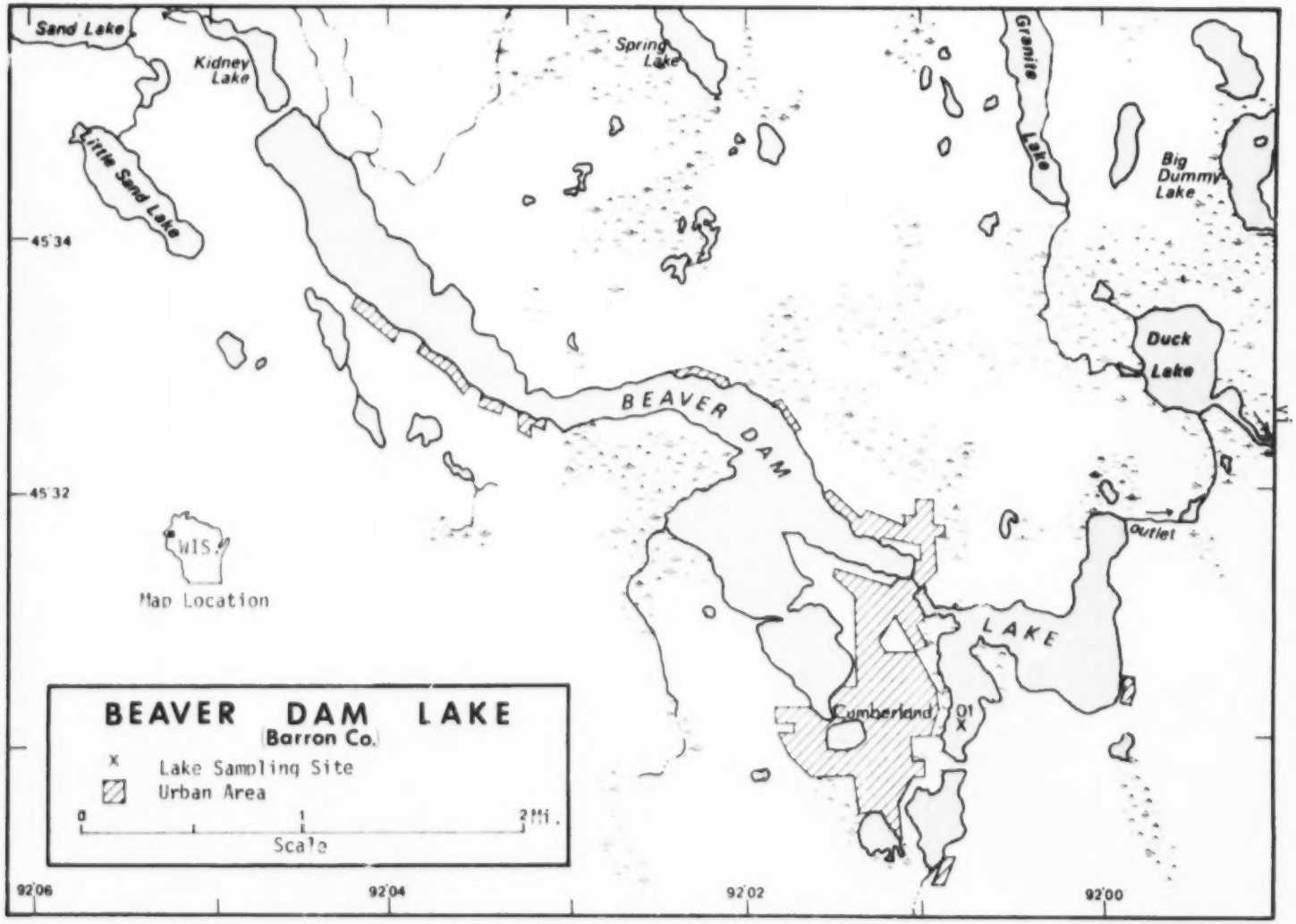
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


Sand Lake
Kidney Lake
Spring Lake
Granite Lake
Big Dummy Lake
Little Sand Lake
45°34
Duck Lake
BEAVER DAM
45°32
Outlet
WIS.
Map Location
LAKE
BEAVER DAM LAKE
(Barron Co.)
Lake Sampling Site
Urban Area
0
1
2 Mi.
Scale
Cumberland
01
92°06
92°04
92°02
92°00

BEAVER DAM LAKE (SOUTH BASIN)

STORET NO. 5503

I. INTRODUCTION

The South Basin of Beaver Dam Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries and nutrient sources were not sampled, and this report only relates to the lake sampling data.

The wastewater treatment plant serving the City of Cumberland discharges to the South Basin, and the Stokely-Van Camp cannery discharges chlorinated cooling water there also (McKersie, et al., 1971). At this time, the City of Cumberland is considering alternate methods of effluent treatment or disposal; the Stokely-Van Camp waste treatment facilities are considered to be satisfactory (Schraufnagel, 1975).

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate the South Basin of Beaver Dam Lake is eutrophic. Of the 46 Wisconsin lakes sampled, 43 had less mean total phosphorus, 42 had less mean dissolved phosphorus, ten had less mean inorganic nitrogen, only two had less mean chlorophyll a, and 44 had greater mean Secchi disc transparency.

B. Rate-Limiting Nutrient:

The algal assay results indicate the South Basin was nitrogen limited at the time the sample was taken (11/03/72). The lake data indicate nitrogen limitation at the other sampling times as well.

III. LAKE CHARACTERISTICS

A. Lake Morphometry (entire lake)*:

1. Surface area: 1,112 acres.
2. Mean depth: 32.1 feet.
3. Maximum depth: 106 feet.
4. Volume: 35,700 acre-feet.

B. Precipitation**:

1. Year of sampling: 33.4 inches.
2. Mean annual: 30.1 inches.

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* Ball, 1973.
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

The South Basin of Beaver Dam Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was taken for chlorophyll *a* analysis. During the last visit, a single five-gallon depth-integrated sample was collected for algal assays. The maximum depth sampled was 7 feet.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

FALL VALUES

(11/03/72)

Parameter	Surface Sample Only
Temperature (Cent.)	4.2
Dissolved oxygen (mg/l)	13.8
Conductivity (μmhos)	170
pH (units)	9.2
Alkalinity (mg/l)	49
Total P (mg/l)	0.900
Dissolved P (mg/l)	0.680
NO_2 + NO_3 (mg/l)	0.520
Ammonia (mg/l)	0.120

ALL VALUES

	Minimum	Mean	Median	Maximum
Secchi disc (inches)	22	35	36	48

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/26/72	1. Melosira	2,892
	2. Microcystis	1,988
	3. Fragilaria	1,295
	4. Scenedesmus	452
	5. Anabaena	210
	Other genera	1,325
	Total	8,162
08/26/72	1. Scenedesmus	10,688
	2. Anabaena	6,377
	3. Gloeocapsa	652
	4. Cryptomonas	471
	Other genera	1,087
	Total	19,275
11/03/72	1. Cyclotella	6,244
	2. Franceia	4,072
	3. Scenedesmus	1,629
	4. Synedra	1,584
	5. Microcystis	1,222
	Other genera	4,616
	Total	19,367

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/26/72	01	15.0
08/26/72	01	42.0
11/03/72	01	152.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.770	0.650	23.3
0.006 P	0.776	0.650	22.5
0.012 P	0.782	0.650	22.9
0.024 P	0.794	0.650	24.8
0.060 P	0.830	0.650	23.6
0.060 P + 10.0 N	0.830	10.650	44.8
10.0 N	0.770	10.650	40.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of South Basin of Beaver Dam Lake was very high at the time the sample was collected (11/03/72). Also, the lack of yield response to increased levels of orthophosphorus and the marked increase in yield when only nitrogen was added show the lake was nitrogen limited at that time.

The lake data indicate nitrogen limitation at the other sampling times as well; the N/P ratio in June was 6/1 and in August was less than 1/1, and nitrogen limitation would be expected.

V. LITERATURE REVIEWED

Ball, Joseph R., 1973. Personal communication (lake morphometry). WI Dept. Nat. Resources, Madison.

McKersie, Jerome R., Robert M. Krill, Charles Kozel, and Danny J. Ryan; 1971. Lower Chippewa River pollution investigation survey. WI Dept. Nat. Resources, Madison.

Sather, LaVerne M., and C. W. Threinen, 1964. Surface water resources of Barron County. WI Cons. Dept., Madison.

Schraufnagel, Francis H., 1975. Personal communication (status of waste treatment facilities). WI Dept. Nat. Resources, Madison.

VI. Appendix

APPENDIX A

PHYSICAL and CHEMICAL DATA

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STORET RETRIEVAL DATE 74/11/01

553331
45 11 48.0 092 01 00.0
BEAVER DAM LAKE
55 WISCONSIN

11EPALES 2111202
3 0007 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/26	06	05 0000	19.4		48	140	8.10	60	0.050	0.060	0.074	0.023
	06	05 0007	19.2	7.5		150	7.90	58	0.060	0.120	0.070	0.034
72/08/26	11	40 0000			22	135	8.90	54	0.050	0.080	0.381	0.169
	11	40 0004	18.7	8.6		130	8.90	55	0.050	0.040	0.443	0.239
72/11/03	14	30 0000	4.2	13.8	36	170	9.20	49	0.520	0.120	0.900	0.690

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/26	06	05 0000	15.0J
72/08/26	11	40 0000	43.0J
72/11/03	14	30 0000	152.0J

J VALUE KNOWN TO BE IN ERROR